Public Summary: **Final Revised Feasibility Study for Parcel D**
Hunters Point Shipyard, San Francisco, California
November 30, 2007

The U.S. Department of the Navy conducted a feasibility study (FS) to evaluate remedial alternatives for Parcel D at Hunters Point Shipyard in San Francisco, California. A previous draft and draft final FS report for Parcel D were prepared in 1997; however, based on comments received during the FS public review period and concerns from the regulatory agencies, the Navy decided to conduct interim remedial actions, collect additional data, and perform further data evaluations before finalizing the FS report. This final revised FS report for Parcel D includes (1) updated data, (2) a revised human health risk assessment for Parcel D and an environmental evaluation of potential threats to the San Francisco Bay, and (3) a reevaluation of remedial alternatives based on these updates.

The Navy considered the following remedial alternatives for chemicals in soil at Parcel D: (1) no action; (2) institutional controls and maintained landscaping; (3) excavation, disposal, maintained landscaping, and institutional controls; (4) covers and institutional controls; and (5) excavation, disposal, covers, and institutional controls. The Navy considered the following remedial alternatives for chemicals in groundwater at Parcel D: (1) no action; (2) long-term monitoring of groundwater and institutional controls; and (3 and 4) two types of *in situ* treatment, reduced groundwater monitoring, and institutional controls.

Information Repositories: A complete copy of the "Final Revised Feasibility Study for Parcel D," dated November 30, 2007, is available to community members at:

San Francisco Main Library
100 Larkin Street
Government Information Center, 5th Floor
San Francisco, CA 94102
Phone: (415) 557-4500

Anna E. Waden Bayview Library
5075 Third Street
San Francisco, CA 94124
Phone: (415) 715-4100

The report is also available to community members on request to the U.S. Department of the Navy. For more information about environmental investigation and cleanup at Hunter Point Shipyard, contact Mark Walden, Remedial Project Manager for the Navy, at:

Mark Walden
Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310
Phone: (619) 532-0931
Fax: (619) 532-0995
E-mail: mark.walden@navy.mil

Final

Revised Feasibility Study for Parcel D

Hunters Point Shipyard
San Francisco, California

November 30, 2007

Prepared for:
Base Realignment and Closure
Program Management Office West
San Diego, California

Prepared by:
SulTech, A Joint Venture of Sullivan Consulting Group and Tetra Tech EM Inc.
1230 Columbia Street, Suite 1000
San Diego, California 92101

Prepared under:
Naval Facilities Engineering Command
Contract Number N68711-03-D-5104
Contract Task Order 019

SULT.5104.0019.0003

Final

Revised Feasibility Study for Parcel D
Hunters Point Shipyard
San Francisco, California

Contract Number N68711-03-D-5104
Contract Task Order 019

PREPARED FOR:

DEPARTMENT OF THE NAVY

REVIEW AND APPROVAL

Project Manager: _____ Date: November 30, 2007
James Knight, SulTech

TABLE OF CONTENTS

REVIEW AND APPROVAL i

ACRONYMS AND ABBREVIATIONS x

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1

1.1 HISTORY OF CERCLA ENVIRONMENTAL STUDIES AT PARCEL D 1-2

1.2 PURPOSE AND ORGANIZATION OF THIS REVISED FS REPORT FOR PARCEL D 1-3

2.0 HUNTERS POINT SHIPYARD AND PARCEL D SITE HISTORY AND CHARACTERIZATION 2-1

2.1 HPS HISTORY 2-1

2.2 HPS AND PARCEL D SETTING 2-2

2.2.1 HPS, Surrounding Area, and Parcel D Land Use 2-2

2.2.2 Parcel D Historic Areas 2-3

2.2.3 Parcel D Climate 2-3

2.2.4 Parcel D Topography and Surface Water Drainage 2-3

2.2.5 Parcel D Ecology 2-4

2.2.6 Parcel D Soils 2-5

2.2.7 Parcel D Geology 2-5

2.2.8 Parcel D Hydrogeology 2-6

2.2.9 Groundwater Beneficial Use Evaluation 2-9

2.3 PARCEL D INVESTIGATION HISTORY 2-12

2.3.1 Remedial Investigation 2-12

2.3.2 Feasibility Study 2-13

2.3.3 Proposed Plan and Record of Decision 2-14

2.3.4 Risk Management Review Process 2-14

2.3.5 Draft Revised Feasibility Study 2-16

2.4 PARCEL D REMOVAL AND CLEANUP ACTIONS 2-17

2.4.1 Polychlorinated Biphenyl Transformer Removal 2-17

2.4.2 Parcel D Underground and Aboveground Storage Tank Removal Actions 2-17

2.4.3 Parcel D Sandblast Grit Cleanup Action 2-17

2.4.4 Pickling and Plate Yard Removal Action at IR-09 2-18

2.4.5 Parcel D Exploratory Excavation Removal Action 2-18

2.4.6 HPS Storm Drain Sediment Removal Action 2-19

2.4.7 Parcel D Time-Critical Removal Action for Non-Volatile Organic Compounds in Soil 2-19

2.4.8 Parcel D Radiological Time-Critical Removal Action 2-21
2.4.9 Parcel D Soil Stockpile Removal Action 2-21
2.4.10 Parcel D Waste Consolidation Cleanup Action 2-22
2.4.11 Total Petroleum Hydrocarbon-Contaminated Soil Excavation 2-23
2.4.12 Storm Drain and Sanitary Sewer Removal Action 2-23
2.5 EXTENT OF CONTAMINATED SOIL AND GROUNDWATER 2-23
2.5.1 Parcel D Soil Characterization 2-24
2.5.2 Parcel D Groundwater Characterization 2-30

3.0 RISK EVALUATION SUMMARY AND REMEDIATION GOALS 3-1
3.1 HUMAN HEALTH RISK ASSESSMENT 3-1
3.1.1 Exposure Scenarios and Pathways 3-2
3.1.2 Total and Incremental Risks for Soil Exposure 3-4
3.1.3 Soil Risk Summary 3-4
3.1.4 Groundwater Risk Summary 3-6
3.2 ENVIRONMENTAL EVALUATION 3-8
3.3 REMEDIATION GOALS AND GROUNDWATER TRIGGER LEVELS 3-9
3.3.1 Soil 3-9
3.3.2 Groundwater 3-10
3.3.3 Sampling Locations with Chemical Concentrations Above Remediation Goals 3-10
3.3.4 Groundwater Ecological Screening and Trigger Levels 3-10

4.0 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, AND PROCESS OPTIONS 4-1
4.1 REMEDIAL ACTION OBJECTIVES 4-1
4.1.1 Remedial Action Objectives for Soil 4-2
4.1.2 Remedial Action Objectives for Groundwater 4-3
4.2 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS 4-6
4.2.1 Potential Chemical-Specific ARARs 4-7
4.2.2 Potential Location-Specific ARARs 4-9
4.2.3 Potential Action-Specific ARARs 4-10
4.3 GENERAL RESPONSE ACTIONS AND PROCESS OPTIONS ANALYSES 4-15
4.3.1 Development of General Response Actions 4-15
4.3.2 Analysis of General Response Actions and Process Options 4-16

5.0 DEVELOPMENT AND DESCRIPTION OF REMEDIAL ALTERNATIVES 5-1
5.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES 5-1
5.1.1 Alternatives Developed for Soil 5-2
5.1.2 Alternatives Developed for Groundwater 5-4
5.2 DESCRIPTION OF SOIL REMEDIAL ALTERNATIVES 5-5
5.2.1 Alternative S-1: No Action 5-5
5.2.2 Alternative S-2: Institutional Controls and Maintained Landscaping 5-6
5.2.3 Alternative S-3: Excavation, Disposal, Maintained Landscaping, and Institutional Controls 5-6
5.2.4 Alternative S-4: Covers and Institutional Controls 5-7
5.2.5 Alternative S-5: Excavation, Disposal, Covers, and Institutional Controls 5-8
5.3 DESCRIPTION OF GROUNDWATER REMEDIAL ALTERNATIVES 5-8
5.3.1 Alternative GW-1: No Action 5-9
5.3.2 Alternative GW-2: Long-Term Groundwater Monitoring and Institutional Controls 5-9
5.3.3 Alternatives GW-3A and GW-3B: *In Situ* Treatment for VOCs with Reduced Groundwater Monitoring, and Institutional Controls 5-10
5.3.4 Alternatives GW-4A and GW-4B: *In Situ* Treatment for VOCs and Metals with Reduced Groundwater Monitoring, and Institutional Controls 5-11

6.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES 6-1
6.1 INDIVIDUAL ANALYSIS OF SOIL REMEDIAL ALTERNATIVES 6-3
6.1.1 Individual Analysis of Alternative S-1 6-3
6.1.2 Individual Analysis of Alternative S-2 6-5
6.1.3 Individual Analysis of Alternative S-3 6-7
6.1.4 Individual Analysis of Alternative S-4 6-10
6.1.5 Individual Analysis of Alternative S-5 6-12
6.2 COMPARISON OF SOIL REMEDIAL ALTERNATIVES 6-15
6.2.1 Overall Protection of Human Health and the Environment 6-15
6.2.2 Compliance with Applicable or Relevant and Appropriate Requirements 6-16
6.2.3 Long-Term Effectiveness and Permanence 6-16
6.2.4 Reduction of Mobility, Toxicity, or Volume through Treatment 6-16
6.2.5 Short-Term Effectiveness 6-16
6.2.6 Implementability 6-16
6.2.7 Cost 6-17

6.2.8 Overall Rating of Soil Alternatives 6-17
6.3 INDIVIDUAL ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES 6-17
6.3.1 Individual Analysis of Alternative GW-1 6-17
6.3.2 Individual Analysis of Alternative GW-2 6-19
6.3.3 Individual Analysis of Alternatives GW-3A and GW-3B 6-22
6.3.4 Individual Analysis of Alternatives GW-4A and GW-4B 6-26
6.4 COMPARISON OF GROUNDWATER REMEDIAL ALTERNATIVES 6-30
6.4.1 Overall Protection of Human Health and the Environment 6-30
6.4.2 Compliance with Applicable or Relevant and Appropriate Requirements 6-30
6.4.3 Long-Term Effectiveness and Permanence 6-30
6.4.4 Reduction of Mobility, Toxicity, or Volume through Treatment 6-31
6.4.5 Short-Term Effectiveness 6-31
6.4.6 Implementability 6-31
6.4.7 Cost 6-32
6.4.8 Overall Rating of Groundwater Alternatives 6-32

7.0 REFERENCES 7-1

Appendix

A Analytical Results for Soil and Groundwater at Parcel D

B Parcel D Human Health Risk Assessment

C Applicable or Relevant and Appropriate Requirements

D Groundwater Beneficial Use Evaluation

E Conceptual Groundwater Monitoring Approach and Exit Strategies

F Remedial Action Alternative Costs Summary

G Groundwater Modeling and Calculation of Attenuation Factors

H Preliminary Screening of Groundwater Impacts to San Francisco Bay

I Trigger Levels for Groundwater Impacts to San Francisco Bay

J Responses to Regulatory Agency Comments on the Draft and Draft Final Revised Feasibility Study for Parcel D

LIST OF FIGURES

ES-1 Proposed Reuse at Parcel D

1-1 Hunters Point Location Map
1-2 Facility Location Map

2-1 Parcel D IR Sites
2-2 Surface Topography at Parcel D
2-3 Storm Drain and Sanitary Sewer Line Map
2-4 Soils Distribution Map
2-5 Surficial Geology
2-6 Hydrogeological Cross-Section Location Map
2-7 Hydrogeological Cross Sections A-A', B-B', and C-C'
2-8 A-Aquifer Groundwater Contours at Parcel D, 2002
2-9 A-Aquifer Groundwater Contours at Parcel D, March 2007
2-10 Maximum Total Dissolved Solids in the A-Aquifer
2-11 Areal Distribution of Factors Limiting Drinking Water Beneficial Use of A-Aquifer Groundwater Per Federal Criteria
2-12 Maximum Total Dissolved Solids in the B-Aquifer
2-13 Former USTs, Utility Lines, and Removal Action Areas Map
2-14 Stockpiles and Storm Drain Lines Location Map
2-15 Parcel D Soil Sample Locations
2-16 Parcel D Groundwater Sample Locations
2-17 Arsenic Distribution in Soil, 0 to 10 Feet Below Ground Surface
2-18 Arsenic Distribution in Soil, Greater than 10 Feet Below Ground Surface
2-19 Chromium VI Distribution in Soil, 0 to 10 Feet Below Ground Surface
2-20 Chromium VI Distribution in Soil, Greater than 10 Feet Below Ground Surface
2-21 Lead Distribution in Soil, 0 to 10 Feet Below Ground Surface
2-22 Lead Distribution in Soil, Greater than 10 Feet Below Ground Surface
2-23 Manganese Distribution in Soil, 0 to 10 Feet Below Ground Surface
2-24 Manganese Distribution in Soil Greater than 10 Feet Below Ground Surface
2-25 Benzo(a)pyrene Distribution in Soil, 0 to 10 Feet Below Ground Surface
2-26 Benzo(a)pyrene Distribution in Soil, Greater than 10 Feet Below Ground Surface
2-27 Benzo(b)fluoranthene Distribution in Soil, 0 to 10 Feet Below Ground Surface
2-28 Benzo(b)fluoranthene Distribution in Soil, Greater than 10 Feet Below Ground Surface
2-29 Chromium VI and Nickel Concentrations in the A-Aquifer
2-30 PCE, TCE, and Chloroform Concentrations in the A-Aquifer

3-1 Parcel D Redevelopment Blocks and Planned Reuses
3-2 Total Risk - Surface Soil (0 to 2 ft bgs) Risks Based on Planned Reuse
3-3 Total Risk - Subsurface Soil (0 to 10 ft bgs) Risks Based on Planned Reuse

LIST OF FIGURES (Continued)

3-4 Total Risk Subsurface Soil (0 to 10 ft bgs) Risks, Construction Worker Exposure Scenario
3-5 Incremental Risk - Surface Soil (0 to 2 ft bgs) Risks Based on Planned Reuse
3-6 Incremental Risk - Subsurface Soil (0 to 10 ft bgs) Risks Based on Planned Reuse
3-7 Incremental Risk - Subsurface Soil (0 to 10 ft bgs) Risks, Construction Worker Exposure Scenario
3-8 Groundwater Vapor Intrusion Risks in A-Aquifer Based on Planned Reuse
3-9 Trench Groundwater Risks in A-Aquifer, Construction Worker Exposure Scenario
3-10 Groundwater Domestic Use Risks in B-Aquifer, Residential Exposure Senario

4-1 Surface and Subsurface Soil Incremental Risk Based on Planned Reuse
4-2 Comparison of the 2004 Groundwater Plumes and Risk Plumes in the A-Aquifer

5-1 Parcel D Lead- and PAH-Impacted Areas
5-2 Proposed Lead and PAH Excavations
5-3 Proposed PAH Excavations
5-4 Proposed PAH Excavations

LIST OF TABLES

ES-1 Ranking of Remedial Alternatives for Soil and Groundwater

2-1 Parcel D Historical and Current Use of Buildings
2-2 Site Geologic and Hydrogeologic Units at Parcel D
2-3 Summary of Site-Specific Factor Evaluation for Class II Groundwater
2-4 History of Identifying and Evaluating Further Actions at Soil Sites in Parcel D
2-5 Stockpile Inventory
2-6 Parcel D Metals Data Summary Table, Soil (0 to 10 Feet Below Ground Surface)
2-7 Parcel D Metals Data Summary Table, Soil (Greater than 10 Feet Below Ground Surface)
2-8 Parcel D Volatile Organic Compounds Data Summary Table, Soil (0 to 10 Feet Below Ground Surface)
2-9 Parcel D Volatile Organic Compounds Data Summary Table, Soil (Greater than 10 Feet Below Ground Surface)
2-10 Parcel D Semivolatile Organic Compounds Data Summary Table, Soil (0 to 10 Feet Below Ground Surface)
2-11 Parcel D Semivolatile Organic Compounds Data Summary Table, Soil (Greater than 10 Feet Below Ground Surface)
2-12 Parcel D Pesticides, PCBs, and Cyanide Data Summary Table, Soil (0 to 10 Feet Below Ground Surface)
2-13 Parcel D Pesticides, PCBs, and Cyanide Data Summary Table, Soil (Greater than 10 Feet Below Ground Surface)
2-14 Parcel D Metals Data Summary Table, A-Aquifer Groundwater
2-15 Parcel D Volatile Organic Compound Data Summary Table, A-Aquifer Groundwater
2-16 Parcel D Semivolatile Organic Compound Data SummaryTable, A-Aquifer Groundwater
2-17 Parcel D Pesticides, PCBs, and Cyanide Data Summary Table, A-Aquifer Groundwater
2-18 Parcel D Dioxins and Furans Data Summary Table, A-Aquifer Groundwater
2-19 Parcel D Radionuclide Data Summary Table, A-Aquifer Groundwater
2-20 Parcel D Total Petroleum Hydrocarbons Data Summary Table, A-Aquifer Groundwater
2-21 Parcel D Water Quality Characteristics Data Summary Table, A-Aquifer Groundwater
2-22 Parcel D Metals Data Summary Table, B-Aquifer Groundwater
2-23 Parcel D Volatile Organic Compound Data Summary Table, B-Aquifer Groundwater
2-24 Parcel D Water Quality Characteristic Data Summary Table, B-Aquifer Groundwater

3-1 Human Health Risk Assessment Potential Complete Exposure Pathways
3-2 Total Risk - Summary of Cancer Risks and Hazard Indices by Planned Reuse, Surface Soil (0 to 2 feet bgs)
3-3 Total Risk - Summary of Cancer Risks and Hazard Indices by Planned Reuse, Subsurface Soil (0 to 10 feet bgs)
3-4 Total Risk - Summary of Cancer Risks and Hazard Indices By Planned Reuse, Subsurface Soil (0 to 10 feet bgs), Construction Worker Scenario
3-5 Total Risk - Risk Characterization Analysis for Surface Soil (0 to 2 feet bgs) by Planned Reuse

LIST OF TABLES (Continued)

3-6 Total Risk - Risk Characterization Analysis for Subsurface Soil (0 to 10 feet bgs) by Planned Reuse

3-7 Total Risk - Risk Characterization Analysis for Subsurface Soil (0 to 10 feet bgs), Construction Worker Scenario

3-8 Incremental Risk - Summary of Cancer Risks and Hazard Indices by Planned Reuse, Surface Soil (0 to 2 feet bgs)

3-9 Incremental Risk - Summary of Cancer Risks and Hazard Indices by Planned Reuse, Subsurface Soil (0 to 10 feet bgs)

3-10 Incremental Risk - Summary of Cancer Risks and Hazard Indices By Planned Reuse, Subsurface Soil (0 to 10 feet bgs), Construction Worker Scenario

3-11 Incremental Risk - Risk Characterization Analysis for Surface Soil (0 to 2 feet bgs) by Planned Reuse

3-12 Incremental Risk - Risk Characterization Analysis for Subsurface Soil (0 to 10 feet bgs) by Planned Reuse

3-13 Incremental Risk - Risk Characterization Analysis for Subsurface Soil (0 to 10 feet bgs), Construction Worker Scenario

3-14 Risk Characterization Analysis for A-Aquifer Groundwater Based on Planned Reuse

3-15 Risk Characterization Summary for A-Aquifer Groundwater, Construction Worker Scenario

3-16 Remediation Goals for Chemicals of Concern in Soil

3-17 Remediation Goals for Chemicals of Concern in A-Aquifer Groundwater

3-18 Risk and Hazard Drivers and Associated Sampling Locations Exceeding Remediation Goals by Planned Reuse, Surface Soil (0 to 2 feet bgs)

3-19 Risk and Hazard Drivers and Associated Sampling Locations Exceeding Remediation Goals by Planned Reuse, Subsurface Soil (0 to 10 feet bgs)

4-1 Screening of General Response Actions and Process Options for Soil

4-2 Screening of General Response Actions and Process Options for Groundwater

4-3 Analysis of General Response Actions and Process Options for Soil and Groundwater

6-1 Summary of Costs for Soil and Groundwater Alternatives

6-2 Ranking of Remedial Alternatives for Soil and Groundwater

ACRONYMS AND ABBREVIATIONS

§	Section
§§	Sections
µg/L	Microgram per liter
ARAR	Applicable or relevant and appropriate requirement
ARIC	Area requiring institutional controls
AST	Aboveground storage tank
ATSDR	Agency for Toxic Substances and Disease Registry
Bay	San Francisco Bay
BCT	Base Realignment and Closure Cleanup Team
bgs	Below ground surface
BRAC	Base Realignment and Closure
Cal. Code Regs.	*California Code of Regulations*
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	Chemical of concern
COPC	Chemical of potential concern
COPEC	Chemical of potential environmental concern
DM	*De minimis*
DTSC	Department of Toxic Substances Control
EE	Exploratory excavation
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	Feasibility study
GDGI	Groundwater data gaps investigation
GRA	General response action
HGAL	Hunters Point groundwater ambient level
HHRA	Human health risk assessment
HI	Hazard index
HPAL	Hunters Point ambient level
HPS	Hunters Point Shipyard
IR	Installation Restoration

IT Corp.	International Technology Corporation
ITSI	Innovative Technical Solutions, Inc.
LFR	Levine-Fricke-Recon, Inc.
LUC	Land use control
LUC RD	Land use control remedial design
MCL	Maximum contaminant level
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NRDL	National Radiological Defense Laboratory
O&M	Operation and maintenance
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
ppm	Part per million
PQL	Practical quantitation limit
PRC	PRC Environmental Management, Inc.
PRG	Preliminary remediation goal
RA	Remediation area
RAO	Remedial action objective
RASO	Radiological Affairs Support Office
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial investigation
RMP	Risk management plan
RMR	Risk management review
ROD	Record of decision
SVOC	Semivolatile organic compound
SWRCB	State Water Resources Control Board
TCRA	Time-critical removal action
TDS	Total dissolved solids
Tetra Tech	Tetra Tech EM Inc.

tit.	Title
TPH	Total petroleum hydrocarbons
Triple A	Triple A Machine Shop, Inc.
U&A	Uribe & Associates
U.S.C.	*United States Code*
UST	Underground storage tank
VOC	Volatile organic compound
Water Board	San Francisco Bay Regional Water Quality Control Board
ZVI	Zero-valent iron

EXECUTIVE SUMMARY

The U.S. Department of Navy has prepared this final revised feasibility study (FS) to address soil and groundwater contamination at Parcel D in Hunters Point Shipyard (HPS). HPS is a deactivated shipyard on the San Francisco Bay (the Bay) in southeastern San Francisco, California. This report combines existing remedial investigation (RI) data with new data collected after the RI was completed in 1996 and a draft final FS report was completed in 1997. This final revised FS report updates the revised draft FS report for Parcel D completed in 2002. The data are summarized and evaluated in this revised FS report to refine the conceptual site model, further define the extent of contamination, and assess potential risks based on existing site conditions. This FS report includes (1) a revised human health risk assessment (HHRA) that incorporates revised protocols and procedures for conducting HHRAs at HPS agreed to by the Base Realignment and Closure Cleanup Team, (2) an evaluation of potential environmental impacts to the Bay based on comparison of groundwater data for Parcel D with available surface water quality criteria and a derivation of trigger levels for these potential environmental impacts as proposed action level criteria, (3) updated remedial action objectives that reflect the Conveyance Agreement between the Navy and the San Francisco Redevelopment Agency, and (4) development and evaluation of revised remedial alternatives that address soil and groundwater areas that pose a risk to human health or the environment.

Environmental activities at Parcel D were conducted under the Navy's Installation Restoration (IR) Program in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This executive summary discusses HPS background, Parcel D history and setting, Parcel D remedial activities, Parcel D revised HHRA, and the FS process for Parcel D.

HUNTERS POINT SHIPYARD BACKGROUND

HPS consists of 866 acres: 420 acres on land and 446 acres under water in the Bay. In 1940, the Navy obtained ownership of HPS for shipbuilding, repair, and maintenance activities. After World War II, activities at HPS shifted to submarine maintenance and repair. HPS was also the site of the Naval Radiological Defense Laboratory. HPS was deactivated in 1974 and remained relatively unused until 1976. Between 1976 and 1986, the Navy leased most of HPS to Triple A Machine Shop, Inc., a private ship repair company. In 1987, the Navy resumed occupancy of HPS.

Because past shipyard operations left hazardous materials on site, HPS property was placed on the National Priorities List in 1989 as a Superfund site pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act as amended by the Superfund Amendments and Reauthorization Act of 1986. In 1991, HPS was designated for closure pursuant to the Defense Base Closure and Realignment Act of 1990. Closure activities at HPS involve conducting environmental remediation and making the property available for nondefense use.

PARCEL D HISTORY AND SETTING

Parcel D is bounded by other portions of HPS, private property, and by the Bay. Most of Parcel D was formerly part of the industrial support area and was used for shipping, ship repair, and

office and commercial activities. The docks at Parcel D were formerly part of the industrial production area. According to the City and County of San Francisco's Redevelopment Plan, Parcel D will be zoned for the following reuses: educational and cultural, mixed uses, research and development, open space, industrial, and maritime industrial (see Figure ES-1). Evaluation of the currently proposed football stadium plan at HPS was not part of the scope of this report. However, information provided in this FS report is relevant to a stadium reuse plan at Parcel D. The HHRA includes scenarios for alternative reuse, including industrial reuse and recreational reuse, for the entire parcel. The industrial reuse scenario is conservative for the areas of the stadium complex that are regularly occupied, and the recreational scenario is appropriate for the remainder of the parcel.

Historically, Parcel D was investigated by IR site. Parcel D originally consisted of 27 IR sites, which were investigated during the RI. Since that time, the Parcel D boundaries have been redefined resulting in four IR sites (IR-08, IR-36, IR-38, and IR-39) no longer being within Parcel D, resulting in 23 IR sites in Parcel D. Sites IR-45 (steam line system) and IR-50 (storm drain and sanitary sewer system) are facility-wide utility sites that traverse other sites. Site IR-51 is a facility-wide site consisting of buildings and areas that formerly housed electrical transformers. To help identify areas of Parcel D associated with specific planned reuses, Parcel D is also divided into redevelopment blocks with assigned redevelopment block numbers. The revised HHRA and the proposed application of remedial alternatives are based on redevelopment blocks. For each redevelopment block at Parcel D, the table below lists the associated IR sites, the planned reuses, and the HHRA exposure scenario.

PARCEL D IR SITES

09	37	65
16	44	66
17	45	67
22	48	68
32	50	69
33	51	70
34	53	71
35	55	

Redevelopment Block	IR Sites	Planned Reuse	HHRA Exposure Scenario
DMI-1	16, 17, 22, 32, 35, 53, 55, 68, 69, and 70	Maritime Industrial	Industrial
30B	Part of 37	Industrial	
37	66 and 67	Industrial	
38	33 and 44	Industrial	
42	48	Industrial	
29	09 and part of 33	Educational/Cultural	
DOS-1	Part of 33 and 34	Open Space	Recreational
39	34, 65, and 71	Open Space	
A	None	Research and Development	Residential
30A	Part of 37	Mixed Use	

More than 80 percent of HPS consists of relatively level lowlands that were mostly constructed by placing borrowed fill material from a variety of sources, including serpentinite bedrock from the shipyard. The serpentinite bedrock and serpentine bedrock-derived fill material are comprised of minerals that naturally contain relatively high levels of arsenic, manganese, nickel, and other metals. The fill supported new buildings, construction, and in some cases filled the margin of the Bay. Nearly 100 percent of Parcel D is located in the lowlands, with surface elevations between 0 to 10 feet above mean sea level. No threatened or endangered species are

known to inhabit HPS or its vicinity. In 2004, a burrowing owl, a species of special concern according to the California Department of Fish and Game, was sighted at Parcel D. The owl was passively relocated off Parcel D in 2005. Parcel D ecology is limited to those plant and animal species adapted to the industrial environment. Viable terrestrial habitat is inhibited at Parcel D because approximately 85 percent of the ground surface is covered by pavement and industrial buildings. Physical structures at Parcel D, such as docks and piers, may serve as artificial habitats for estuarine life.

The geologic setting at Parcel D is as follows. In general, the stratigraphic sequence of geologic units present at Parcel D, from youngest (shallowest) to oldest (deepest), is Artificial Fill; Undifferentiated Upper Sand Deposits; Bay Mud Deposits; Undifferentiated Sedimentary Deposits; and Franciscan Complex Bedrock. The hydrostratigraphic units present at Parcel D are the A-aquifer, the aquitard zone, the B-aquifer, and a bedrock water-bearing zone. There are no current beneficial uses of the groundwater at HPS, and the beneficial use evaluation in this FS report recommends that the groundwater from the shallowest A-aquifer be considered for non-beneficial use, and the groundwater from the underlying B-aquifer have a low potential for beneficial use.

PARCEL D REMEDIAL ACTIVITIES UNDER COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT

The RI for Parcel D was conducted from 1988 to 1996. In addition, the Navy has conducted a number of removal actions (see adjacent box) that reduced or eliminated certain risks to human health and ecological receptors at Parcel D. The draft final Parcel D RI report was submitted to the regulatory agencies on October 25, 1996. The FS was conducted concurrently with the RI, and the draft final Parcel D FS report was submitted to the regulatory agencies on January 24, 1997. A proposed remedial plan for Parcel D was completed in 1997, including a public review and comment period. Based on comments received during the public review period and on concerns from the regulatory agencies, the Navy decided to conduct additional removal actions to mitigate areas of contaminated soil, collect additional data, and perform further data evaluations before finalizing the FS report. A draft revised FS report for Parcel D was prepared in 2002 based on the removal actions and additional data collected since the conclusion of the RI report. This final

REMOVAL ACTIONS AT PARCEL D

- **Phase I and II Underground Storage Tank Removal Action, 1991-1993:** Nine underground storage tanks were removed and 1 closed in place.
- **Sandblast Grit Removal Action, 1991-1995:** A total of 4,665 tons of discarded sandblast grit was removed.
- **Pickling and Plate Yard Removal Action, 1994-1996:** Contaminated equipment and residue were removed at IR-09.
- **Exploratory Excavation Removal Action, 1996-1997:** Stained soil, asphalt, and concrete were removed from four IR sites (IR-33, IR-37, IR-70 and IR-53).
- **Storm Drain Sediment Removal Action, 1996-1997:** A total of 1,200 tons of contaminated sediment was removed from storm drain lines and appurtenances.
- **Time-Critical Removal Action, 2000-2001**: A total of 1,643 cubic yards of soil was removed from several IR sites (IR-09, IR-37, IR-53, IR-55 and IR-65).
- **Radiological Time-Critical Removal Action, 2001 – present (ongoing):** In 2001, soil impacted by cesium-137 spill was removed from Building 364 and the surrounding area. Investigation and remediation is ongoing.
- **Soil Stockpile Removal Action, 2003-2004:** Nine soil and asphalt stockpiles were removed.
- **Storm Drain and Sanitary Sewer Removal Action, 2007- present (ongoing):** Radiological investigation and removal of storm drains and sanitary sewers.

revised FS report for Parcel D includes an update to the site characterization and a revised HHRA and environmental evaluation for Parcel D, and based on these updates, a reevaluation of the remedial alternatives.

REVISED HUMAN HEALTH RISK ASSESSMENT AND ENVIRONMENTAL EVALUATION

The HHRA presented in this FS report revises the HHRA presented in the 2002 draft revised FS for Parcel D to account for the soil data collected during the 2004 time-critical removal action, and to incorporate changes in regulatory guidance and toxicological criteria that have occurred since the previous HHRA. Soil data associated with sampling locations excavated and removed from HPS during the 2000, 2001, and 2004 time-critical removal actions are excluded from the HHRA, and additional groundwater data collected since the 2002 HHRA are included in the revised HHRA. Lastly, revisions were made to the HHRA based on HPS Base Realignment and Closure Cleanup Team agreements formulated in 2003 and 2004.

The HHRA estimated cancer risks and noncancer hazards from exposure to chemicals of potential concern in all affected environmental media for each pathway identified as potentially complete. Both total and incremental risks were evaluated for exposure to soil at Parcel D. For the total risk evaluation, all detected chemicals, including naturally occurring metals from the serpentine bedrock-derived fill material, were included as chemicals of potential concern regardless of their concentration. Only the essential nutrients calcium, magnesium, potassium, and sodium were not included as chemicals of potential concern. The total risk evaluation provides an estimate of the risks posed by chemicals at the site, including those present at concentrations at or below ambient levels. For the incremental risk evaluation, the above essential nutrients were excluded as soil chemicals of potential concern, as well as the detected metals with maximum measured concentrations below the Hunters Point ambient levels. The incremental risk evaluation provides an estimate of risks posed by metals present at the site that are above the estimated ambient levels. Those chemicals at Parcel D determined to pose a potential unacceptable risk were identified as chemicals of concern. Potential unacceptable risk is defined as an excess lifetime cancer risk of greater than 1×10^{-6} or a segregated hazard index greater than 1 determined by the incremental risk evaluation.

The total risk results for soil show that most exposure areas exceed the excess lifetime cancer risk threshold of 10^{-6}, based on the planned reuse. The predominant cancer risk driver is arsenic, which is ubiquitous in the fill material. Planned reuse for Parcel D as developed by the San Francisco Redevelopment Agency includes mixed use, industrial, maritime industrial, educational/cultural, and open space. For exposure areas planned for residential reuse, the total hazard index for all areas for which data are available also exceeds the threshold segregated hazard index of 1. Under the incremental risk evaluation, most exposure areas at Parcel D do not exceed the cancer risk threshold of 10^{-6} or the noncancer threshold segregated hazard index of 1, based on the planned reuse. The chemicals of concern in soil at Parcel D are arsenic, lead, manganese, benzo(a)pyrene, and benzo(b)fluoranthene.

The HHRA results for groundwater show that the risk from exposure to A-aquifer groundwater via vapor intrusion exceeds the cancer risk threshold of 10^{-6} in those areas where volatile organic compounds (VOC) are present in the following reuse areas: residential, mixed use, industrial, educational/cultural, and maritime industrial. The chemicals of concern in groundwater from the

vapor intrusion pathway are benzene, carbon tetrachloride, chloroform, methylene chloride, naphthalene, tetrachloroethene, trichloroethene, and xylenes.

In addition, the HHRA results for groundwater show that the risk from exposure to the A-aquifer groundwater via dermal exposure and inhalation to the construction workers exceeds the cancer risk threshold of 10^{-6} in areas with elevated concentrations of the chemicals of concern. These chemicals of concern from this exposure pathway are arsenic, benzene, naphthalene, tetrachloroethene, and xylenes.

The B-aquifer was evaluated for all chemicals of potential concern through the domestic use of groundwater pathway. No unacceptable risk was found from this exposure scenario; therefore, no chemicals of concern are associated with the B-aquifer.

In addition to the HHRA, an environmental evaluation was performed to identify potential threats to the Bay from chemicals present in groundwater at Parcel D. A list of surface water criteria was derived from available federal and state regulations and guidance. These criteria were compared to all historical groundwater sample data to identify those chemicals detected in groundwater that exceeded the surface water criteria levels. Further evaluation was performed for each chemical of potential concern to determine if it was a chemical of concern that posed a current potential threat to the Bay. Chromium VI and nickel were determined to be chemicals of concern in the A-aquifer based on potential threats to the Bay.

FEASIBILITY STUDY PROCESS

The general process used to conduct this FS consists of the following steps: develop remediation goals, develop remedial action objectives, identify general response actions, identify areas requiring remediation, and evaluate alternatives based on the nine evaluation criteria under the NCP. Each of these steps is discussed in the following paragraphs.

Develop Remediation Goals and Trigger Levels

Remediation goals were developed for each human health chemical of concern by comparing the highest concentrations of acceptable incremental risk with both the laboratory's reporting limit and the ambient level for the chemical of concern, if one was established. The greatest value for this comparison was determined to be the remediation goal for that chemical of concern. Remediation goals were derived for both soil and groundwater from the HHRA.

Trigger levels were developed for each environmental chemical of concern in the A-aquifer to determine if further action was needed for the chromium VI and nickel plumes that posed potential threats to the Bay. To assess these potential threats, groundwater modeling was conducted to derive plume-specific attenuation factors. The resulting attenuation factors are multiplication factors that predict conservative reductions in the plume's concentration as it migrates to the Bay. The attenuation factors were used with the surface water criteria to derive a plume- and analyte-specific trigger level as a conservative maximum concentration that could be found at the plume source, which would attenuate during its migration to the Bay to a concentration that would not exceed the surface water criteria or impact the Bay. These trigger

levels were compared to the maximum concentrations of chromium VI and nickel found at the plume source to assess their potential threats to the Bay.

Develop Remedial Action Objectives

Remedial action objectives for Parcel D are medium-specific goals that were developed from the incremental risk assessment for protecting human health and from the trigger level comparison for protecting the surface water in the Bay. Each remedial action objective specified (1) the chemicals of concern, (2) the exposure route and receptors, and (3) an acceptable contaminant concentration or range of concentrations for media of concern (such as soil and groundwater).

Soil Remedial Action Objectives

Soil remedial action objectives are developed based on human health receptors and the incremental risk assessment. For Parcel D, no ecological soil remedial action objectives were developed because most of the land area is paved, the parcel contains no identified terrestrial habitat, and there is insufficient unpaved area to develop a terrestrial ecological habitat. The following remedial action objective applies to the Parcel D soil:

1. Prevent exposure to organic and inorganic compounds in soil above the remediation goals developed in the HHRA for carcinogens or noncarcinogens for the following exposure pathways:
   - Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet below ground surface (bgs) by residents in areas zoned for mixed use reuse
   - Ingestion of home-grown produce by residents in areas zoned for mixed use reuse
   - Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to10 feet bgs by industrial workers in areas zoned for educational, cultural, industrial, and maritime industrial reuse
   - Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 2 feet bgs by recreational users in areas zoned for open space reuse
   - Soil ingestion, outdoor air inhalation, and dermal exposure to soil from 0 to 10 feet bgs by construction workers in all areas
2. Prevent exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Remediation goals for soil gas will be established during the remedial design.

Groundwater Remedial Action Objectives

Remedial action objectives for Parcel D groundwater were evaluated based on (1) the incremental human health risks through the inhalation of VOCs in indoor air (vapor intrusion) from the A-aquifer groundwater, (2) the potential risks associated with the domestic use exposure pathway from the B-aquifer even though there are no chemicals of concern in the B-aquifer, (3) the incremental human health risks to construction workers from dermal exposure

and inhalation, and (4) potential migration to the Bay of chemicals of concern above the plume-specific trigger levels. The following remedial action objectives apply to groundwater at Parcel D:

1. Prevent exposure to VOCs in A-aquifer groundwater above remediation goals via indoor inhalation of vapors from groundwater.

2. Prevent direct exposure to the groundwater that may contain chemicals of concern through the domestic use pathway.

3. Prevent or minimize exposure to metals and VOCs in A-aquifer groundwater from dermal exposure and inhalation of vapors from groundwater by construction workers above remediation goals.

4. Prevent or minimize migration of chromium VI and nickel to prevent discharge that would result in concentrations of chromium VI above 50 micrograms per liter (µg/L) and nickel concentrations above 96.5 µg/L in the Bay.

Remedial action objectives for a stadium reuse would be similar to the soil and groundwater objectives stated above. Chemicals of concern and cleanup goals would likely be based on contamination to 2 feet, consistent with recreational reuse and plans for complete covers across the site. Remedial action objectives for groundwater would be based on the recreational scenario across the bulk of the parcel, minimizing the need for remediation of VOCs in groundwater outside of the stadium footprint.

Identify General Response Actions

General response actions are responses or remedies intended to meet remedial action objectives. General response actions identified for Parcel D soil and groundwater include no action, institutional controls, removal and disposal, treatment, and containment. Process options were then initially screened and then analyzed in detail to determine those technologies and processes that were appropriate to address chemicals of concern at Parcel D. Based on this screening and evaluation, soil treatment technologies and groundwater containment technologies were eliminated from further consideration.

Identify Remedial Alternatives

All process options retained after the initial screenings and detailed analysis were determined to meet the applicable or relevant and appropriate requirements (ARAR), and the remedial action objectives. Remedial alternatives were then derived using experience and engineering judgment that formulated the process options into the most plausible site-specific remedial actions. The soil and groundwater alternatives developed for further analysis are presented below.

Alternative S-1: No Action: For this alternative, no remedial action would be taken for soils. Soil would be left in place without implementing any response actions. The no-action response is retained throughout the FS process as required by the NCP to provide a baseline for comparison to and evaluation of other alternatives.

Alternative S-2: Institutional Controls and Maintained Landscaping: Alternative S-2 consists of institutional controls for soils, consisting of access restrictions, land use restrictions, engineering controls, and covenants to restrict use of property that will be implemented parcel-wide for all of the redevelopment blocks. Alternative S-2 also includes maintained landscaping. Maintained landscaping will be required for areas that are currently bare or minimally vegetated soil that has been disturbed by excavation or construction activities and not restored with a cover (for example, clean imported soil, asphalt, or concrete).

Alternative S-3: Excavation, Disposal, Maintained Landscaping, and Institutional Controls: Alternative S-3 consists of soil excavation, soil disposal, maintained landscaping, and institutional controls for soils similar to those of Alternative S-2. In areas where lead and polynuclear aromatic hydrocarbons are chemicals of concern, excavations will be performed to remediate these chemicals of concern to their respective remediation goals. This alternative will provide a more permanent remedy to reduce the volume and toxicity of contaminants present in onsite soils where excavation is feasible. Parcel-wide institutional controls for soils will also be applied to mitigate the risk exposure to other chemicals of concern that are not practical to remediate by excavation and disposal. Areas of bare or minimally vegetated soil that have been disturbed by excavation or construction activities and not restored with a cover will be covered by maintained landscaping as described in Alternative S-2.

Alternative S-4: Covers and Institutional Controls: Alternative S-4 consists of covers to eliminate the exposure pathway to soil contaminants, and institutional controls for soils. This alternative provides physical barriers to cut off the soil exposure pathways at Parcel D. Covers included in this alternative may include new covers and existing or future building footprints, roads, parking lots, and maintained landscape. These covers function to block exposure to metals in the fill material. The health risk due to arsenic and other metals is clearly demonstrated by the HHRA. Therefore, the covers and institutional controls that require their maintenance will be effective in preventing exposure. Institutional controls for soils are included in this alternative for both short-term and long-term mitigation of risk exposure. In addition to institutional controls similar to those required for Alternative S-2, institutional controls will also be applied that would require maintenance of the covers.

Alternative S-5: Excavation, Disposal, Covers, and Institutional Controls: Alternative S-5 consists of a combination of soil excavation and disposal, covers, and institutional controls for soils. This alternative was developed as a combined alternative to (1) remove and dispose of lead and polynuclear aromatic hydrocarbons as described in Alternative S-3, (2) implement and maintain block-wide covers as described in Alternative S-4, and (3) implement the appropriate institutional controls for soils.

Alternative GW-1: No Action: For this alternative, no remedial action will be taken for groundwater. Groundwater conditions will be left as is, without implementing any response actions. The no-action response is retained throughout the FS process as required by the NCP to provide a baseline for comparison to and evaluation of other alternatives.

Alternative GW-2: Long-Term Monitoring of Groundwater and Institutional Controls: Alternative GW-2 consists of groundwater monitoring and institutional controls for groundwater. This alternative was developed as a method for monitoring groundwater contaminants present at

low concentrations.. Additionally, groundwater monitoring will be used to confirm site conditions and ensure that, over time, the potential exposure pathways remain incomplete. Institutional controls are also included in this alternative to effectively manage risk by preventing exposure and use of the groundwater.

Alternatives GW-3A and GW-3B: *In Situ* Treatment for VOCs, Groundwater Monitoring for Metals and VOCs, and Institutional Controls: Alternatives GW-3A and GW-3B consist of *in situ* treatment of the VOC contaminant plumes, in addition to groundwater monitoring for metals and VOCs and institutional controls for groundwater similar to those described for Alternative GW-2. Alternatives GW-3A and GW-3B involve using two different *in situ* treatment reagents, (1) a biological substrate, and (2) a slurry of zero-valent iron (ZVI). Alternative GW-3A uses a slow-release biological substrate designed to promote anaerobic bioremediation to degrade chlorinated chemicals of concern to nontoxic compounds. Alternative GW-3B uses ZVI slurry as an additive that creates a chemically reducing environment in the aquifer that mineralizes chlorinated chemicals similar to the bioremediation reaction. Alternatives GW-3A and GW-3B consider *in situ* treatment only for VOCs; metal would be monitored but not treated under this alternative. Monitoring for VOCs would be conducted to assess the effectiveness of the treatment. Alternatives GW-3A and GW-3B are intended to reduce the required time to meet the groundwater remedial action objectives for VOCs, and, as a result, the length of groundwater monitoring for VOCs and possibly the time required for the institutional controls for VOC issues. The institutional controls for groundwater in Alternatives GW-3A and GW-3B would be similar to the institutional controls in Alternative GW-2.

Alternatives GW-4A and GW-4B: *In Situ* Treatment for VOCs and Metals, Groundwater Monitoring, and Institutional Controls: Alternatives GW-4A and GW-4B consist of *in situ* treatment for both VOC and metal contaminant plumes in addition to groundwater monitoring and institutional controls for groundwater. Alternatives GW-4A and GW-4B involve using biological and ZVI *in situ* treatment reagents for VOCs and metals as described in Alternatives GW-3A and GW-3B. Although the technologies for Alternatives GW-4A and GW-4B are the same as those indicated under Alternatives GW-3A and GW-3B, the reagent materials and volumes are adjusted under Alternatives GW-4A and GW-4B to effectively treat metals. Alternative GW-4A uses a slow-release substrate to degrade chlorinated chemicals of concern as in Alternative GW-3A, and a similar bioremediation substrate that mitigates dissolved metals from the aquifer by creating biosulfur complexes that are readily sorbed to the soils. Alternative GW-4B uses zero-valent iron slurry as in Alternative 3B to create a chemically reducing environment that mineralizes chlorinated chemicals, and creates a chemically reducing environment in the aquifer that changes dissolved chromium VI to a less hazardous chromium III state, and removes nickel from the groundwater through precipitation. Alternatives GW-4A and GW-4B would take the most active approach toward reducing groundwater contaminant volume and toxicity, rather than only monitoring as proposed in Alternative GW-2 or treating only VOCs in Alternatives GW-3A and GW-3B. Alternatives GW-4A and GW-4B are intended to further reduce the time to meet the groundwater RAOs for all chemicals of concern, the length of groundwater monitoring, and the time required for the institutional controls. The institutional controls for groundwater in Alternatives GW-4A and GW-4B would be similar to the institutional controls in Alternative GW-2.

Alternatives would become simpler under the stadium reuse plan. Fewer areas would be planned for excavation under Alternatives S-3 and S-5 because of the change to the shallower 2-foot depth. Alternative S-4 would be unchanged at this time, but the type of cover would be determined during the remedial design. Groundwater alternatives would not be affected, except that the areas determined to require remediation would likely be smaller because of the recreational reuse.

Evaluation of Alternatives Based on Evaluation Criteria under the National Oil and Hazardous Substances Pollution Contingency Plan

Each remedial alternative was evaluated in comparison to the two threshold and five balancing evaluation criteria under the NCP (see adjacent box). Evaluation of the two modifying criteria of regulatory agency and community acceptance will be included in the record of decision following issue of the proposed plan and public comment period. These criteria are not evaluated in this final Parcel D revised FS report. A comparative analysis was conducted to evaluate the relative performance of the five soil and three groundwater remedial alternatives developed for Parcel D.

NCP EVALUATION CRITERIA

Threshold Criteria

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements

Balancing Criteria

- Long-term effectiveness and permanence
- Reduction of mobility, toxicity, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria

- Regulatory agency acceptance
- Community acceptance

Evaluation Results for Soil and Groundwater Alternatives

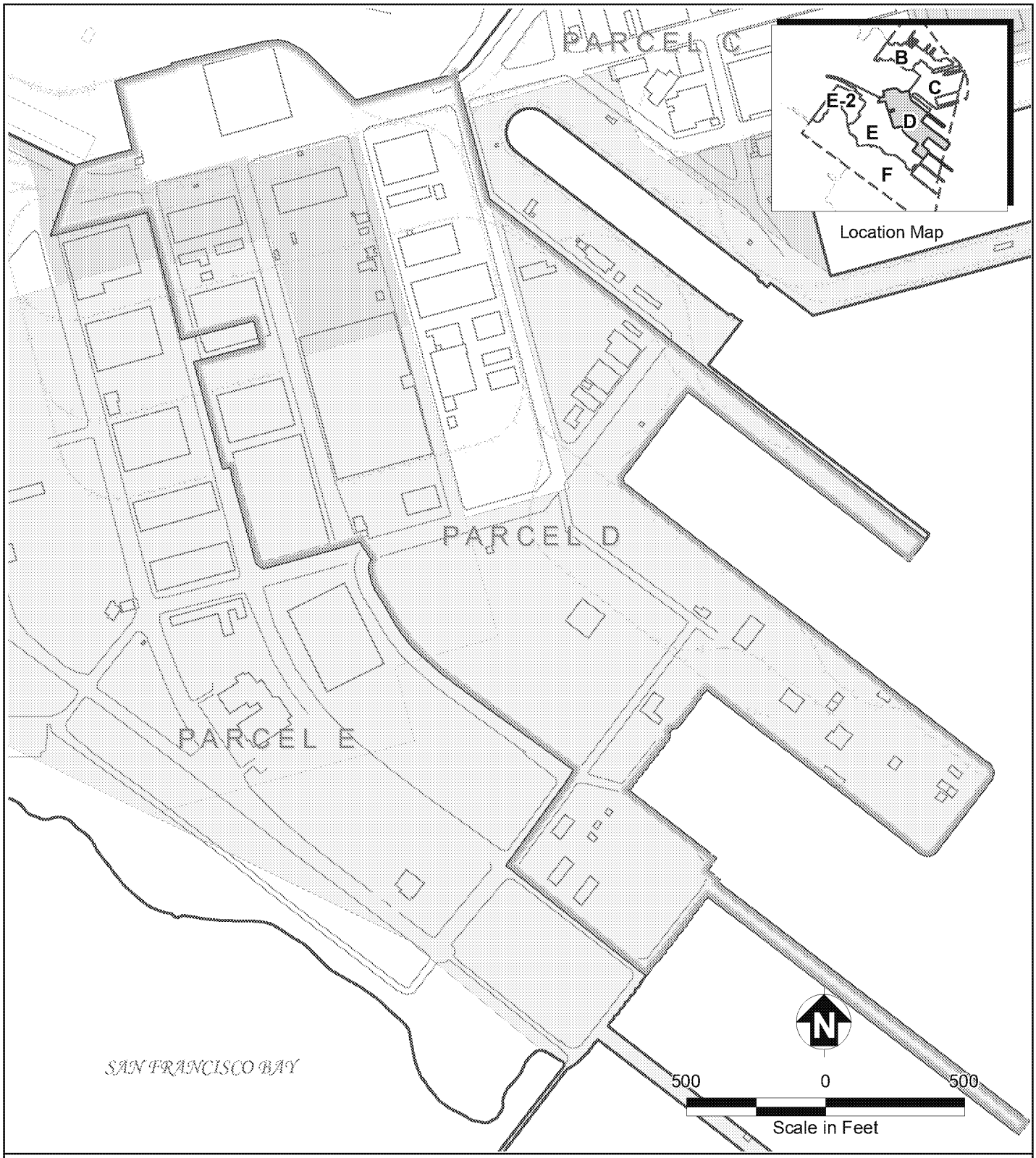
An overall rating was assigned to each alternative. Alternatives S-2 through S-5 meet the threshold criteria. Alternative S-5 is rated between very good and excellent overall for the five balancing evaluation criteria under the NCP. Alternative S-5 is the most effective, with both excavation and covers, although it has the highest cost ($5.5 million). Alternative S-3, rated very good, is more effective than Alternative S-2 because contaminants are removed. The cost of Alternative S-3 ($1.81 million) is somewhat more expensive than that of Alternative S-2 ($820,000). Alternative S-4, rated very good, is considerably more expensive but is also more protective than Alternatives S-2 or S-3 ($4.54 million). Alternative S-2, rated good, is easiest to implement and least expensive. Alternative S-1 does not meet the threshold criteria and is thus rated poor.

Alternative GW-3A and GW-4A both have the highest overall rating of between very good and excellent with Alternative GW-4A being slightly higher. These treatments effectively reduce risks to human health and environment, and have similar costs (GW-3A of $2.45 million and GW-4A of $2.87 million). In the long term, Alternative GW-4A is more likely expected to achieve remedial action objectives than Alternative GW-3A because the latter alternative does not actively treat metals in groundwater. Alternative GW-3B ranks very good, but has a higher cost ($5.35 million) and does not actively treat metals in groundwater. Alternative GW-4B ranks very good also, but at an even higher cost ($9.20 million). Alternative GW-2 is easy to implement at a cost similar to Alternatives GW-3A and GW-3B ($3.52 million), but it is not as

effective as Alternatives GW-3A, GW-3B, GW-4A, and GW-4B. Alternative GW-1 is rated as a poor alternative because it does not meet the threshold criteria.

Table ES-1 summarizes each alternative's rating under the seven evaluation criteria. The ranking categories used in Table ES-1 and in the discussion of the alternatives are (1) protective or not protective, and meets ARARs or does not meet ARARs, for the two threshold criteria; and (2) excellent, very good, good, marginal, and poor for the five balancing criteria.

FIGURE



Educational/Cultural
Industrial
Maritime Industrial
Mixed Use
Open Space
Research & Development

Parcel D Boundary
Other Parcel Boundaries
Non-Navy Property
Building
Road

SulTech

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE ES-1

PROPOSED REUSE AT PARCEL D

Revised Feasibility Study Report for Parcel D

2005-11-28 V:\Hunters Point\Projects\Parcel D FS\Nature and Extent of Contamination\Parcel D Reuse.mxd TtEMI-SF Kevin Ernst

TABLE

TABLE ES-1: RANKING OF REMEDIAL ALTERNATIVES FOR SOIL AND GROUNDWATER
Revised Feasibility Study Report for Parcel D, Hunters Point Shipyard, San Francisco, California

	Overall Protection of Human Health and the Environment[a]	Compliance with ARARs[a]	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost	Overall Rank by Alternative
SOIL ALTERNATIVES								
Alternative S-1: No Action	Not protective	Not Applicable	○	○	◑	●	●	◐
Alternative S-2: Institutional Controls and Maintained Landscaping	Protective	Meets ARARs	◐	○	◑	◐	●	◐
Alternative S-3: Excavation, Disposal, Maintained Landscaping, and Institutional Controls	Protective	Meets ARARs	◐	○	◑	◑	◑	◐
Alternative S-4: Covers and Institutional Controls	Protective	Meets ARARs	◑	○	◑	◑	◐	◐
Alternative S-5: Excavation, Disposal, Covers, and Institutional Controls	Protective	Meets ARARs	●	○	●	◑	◐	◑
GROUNDWATER ALTERNATIVES								
Alternative GW-1: No Action	Not protective	Not Applicable	○	○	◐	●	●	◐
Alternative GW-2: Long-Term Monitoring and Institutional Controls	Protective	Meets ARARs	◐	○	◑	◑	◐	◐
Alternative GW-3A: In-Situ Treatment for VOCs with a Bioremediation Compound with Reduced Groundwater Monitoring and Institutional Controls	Protective	Meets ARARs	◑	◐	◑	◑	◐	◑
Alternative GW-3B: In-Situ Treatment for VOCs with ZVI Injection with Reduced Groundwater Monitoring and Institutional Controls	Protective	Meets ARARs	◑	◐	◑	◑	◐	◑
Alternative GW-4A: In-Situ Treatment for VOCs and Metals with Bioremediation Compound with Reduced Groundwater Monitoring, and Institutional Controls	Protective	Meets ARARs	●	●	◑	◑	◐	●
Alternative GW-4B: In-Situ Treatment for VOCs and Metals with ZVI Injection with Reduced Groundwater Monitoring and Institutional Controls	Protective	Meets ARARs	●	●	◑	◑	○	◑

Notes:
a Overall protection of human health and the environment and compliance with ARARRs are threshold criteria and alternatives are judged as either meeting or not meeting the criteria.
ARAR Applicable or relevant and appropriate requirement
ZVI Zero-valent iron

Legend:
○ Poor
◐ Marginal
◑ Good
◕ Very Good
● Excellent

1.0 INTRODUCTION

In 1989, the U.S. Environmental Protection Agency (EPA) identified Hunters Point Shipyard (HPS) in San Francisco, California (see Figure 1-1), as a National Priorities List site. As a result, the U.S. Department of the Navy is conducting investigations in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Title 42 *United States Code* [U.S.C.] Sections [§§] 9601-9675) at a number of sites at HPS. As a management tool to accelerate site investigation, cleanup, and reuse, HPS was divided into Parcels A through F.

This feasibility study (FS) is part of ongoing efforts by the Navy to address contamination in Parcel D at HPS in accordance with CERCLA. The FS is a mechanism for developing, screening, and evaluating alternatives for remedial actions to address risk identified during a remedial investigation (RI) under the CERCLA process. In addition, the FS documents risk management decisions made by the stakeholders. As the lead agency, the Navy is working with EPA Region 9, the Department of Toxic Substances Control (DTSC), and the San Francisco Bay Regional Water Quality Control Board (Water Board) to develop and implement the remedial alternatives in this FS report. The Navy, EPA, DTSC, and Water Board representatives are collectively referred to as the Base Realignment and Closure (BRAC) Cleanup Team (BCT) for HPS.

A previous draft and draft final FS report for Parcel D were prepared in 1997; however, based on comments received during the FS public review period and concerns from the regulatory agencies, the Navy decided to conduct interim remedial actions, collect additional data, and perform further data evaluations before finalizing the FS report. This final revised FS report for Parcel D includes (1) an update to the site characterization, (2) a revised human health risk assessment (HHRA) and an evaluation of potential environmental impacts on the San Francisco Bay (the Bay), (3) updated remedial action objectives (RAO) that reflect the Conveyance Agreement between the Navy and the San Francisco Redevelopment Agency (2004), and (4) development and evaluation of revised remedial alternatives, which address soil and groundwater areas that pose a risk to human health or the environment based on these updates.

Parcel D is one of seven parcels designated by the Navy for HPS: A, B, C, D, E, E-2, and F. The Navy proposed dividing HPS into separate parcels to conduct RIs and FSs, and to expedite remedial actions in support of transferring the property. As a result, the Navy has currently divided the facility into seven contiguous parcels. In December 2004, the Navy transferred Parcel A to the San Francisco Redevelopment Agency; the remaining six parcels are shown on Figure 1-2. Parcel D has undergone several boundary changes: in April 1997, Installation Restoration (IR) Site 36 was transferred from Parcel D to Parcel E; in March 2004, a portion of Parcel A was transferred to Parcel D; and in February 2005, selected areas from Parcel D were transferred to Parcel E. This final revised FS report addresses the area within the Parcel D boundary as redefined in February 2005.

Initially, areas with potential environmental concern were designated as IR sites, and were in most cases identified by a two-digit number, for example, IR-33. Site characterization activities and sampling data were mostly planned and organized by IR site. To assess risk, the BCT agreed to divide all of HPS into two different size grids (industrial and residential) as a method of statistically calculating risk within an area for different future land use scenarios. In conjunction with the basewide risk grid layout, the San Francisco Redevelopment Agency designated redevelopment blocks for Parcel D in accordance with the City of San Francisco's planned future reuse. This revised FS report uses the risk grids and the redevelopment blocks as the basis for evaluating the results of the HHRA and developing remedial alternatives to address potential unacceptable risk present within Parcel D. Potential unacceptable risk is defined as an excess lifetime cancer risk of greater than 1×10^{-6} or a segregated hazard index (HI) greater than 1 determined by the incremental risk evaluation. IR sites are still referred to in the characterization sections of this FS report as they relate to historical operations and resulting sources of contamination found in Parcel D soil and groundwater.

Section 1.1 summarizes the history current status of CERCLA activities at Parcel D, including the current status of this final revised FS report. The purpose and organization of this FS report are presented in Section 1.2.

1.1 HISTORY OF CERCLA ENVIRONMENTAL STUDIES AT PARCEL D

The CERCLA remedial process consists of several progressive steps for achieving cleanup of the environmental issues at and release of the site for future reuse. The typical sequence is as follows: RI, FS, proposed plan, public comment period, record of decision (ROD), remedial design (RD), and remedial action. Removal actions are also used at times to expedite the cleanup process.

An RI, FS, proposed plan, and public comment period were completed for Parcel D. The initial RI for Parcel D was conducted from 1988 to 1996, and a draft final RI report was submitted to the regulatory agencies on October 25, 1996 (PRC Environmental Management, Inc. [PRC], Levine-Fricke-Recon, Inc. [LFR], and Uribe & Associates [U&A] 1996). That RI report concluded that the groundwater at Parcel D did not pose a potential risk to human health or the environment; however, it identified 18 IR sites where soil posed a potential unacceptable risk to potential receptors. The initial FS was conducted concurrently with the RI, and the draft final FS report for Parcel D was submitted to the regulatory agencies in 1997 (PRC and LFR 1997). The proposed remediation plan for Parcel D was completed and distributed in May 1997, followed by a 30-day public comment period that ended in June 1997. Based on the comments received during the public review period and on concerns from the regulatory agencies, the Navy decided to conduct interim removal actions (see Section 2.4) to reduce areas of contaminated soil, while further evaluating the soil data at Parcel D. At the same time, the Navy agreed to assess further groundwater at Parcel D as requested by the regulatory agencies.

The regulatory agencies' comments on the draft final RI report and the draft final FS report did not concur with the conclusion that groundwater at Parcel D does not pose a risk to human health and the environment; therefore, the Navy decided to further evaluate these risks in a revised FS.

The draft revised FS for Parcel D was submitted to the regulators in 2002. The Navy evaluated groundwater at Parcel D in the draft revised FS for (1) risks to human health through the drinking water pathway, (2) risks to human health through inhalation of volatile organic compounds (VOC) in indoor air from the shallowest groundwater zone, (3) risks to human health through consumption of aquatic life from the Bay that could be affected by the groundwater, and (4) ecological risk. Based on the exemption criteria in the California State Water Resource Control Board's (SWRCB) Sources of Drinking Water Resolution 88-63 (SWRCB 1988), the Navy concluded in the draft revised FS that the shallow A-aquifer at HPS did not have a beneficial use to future residents; therefore, the ingestion pathway from this water bearing zone was considered incomplete. In addition, the Navy evaluated the B-aquifer as a potential source of domestic water use to future residents at the site in the draft revised FS.

In September 2003, the Water Board concurred that the A-aquifer groundwater beneath HPS is not a potential source of drinking water pursuant to SWRCB Resolution 88-63 and Water Board Resolution 89-39 (Water Board 2003). In October 2004, and in February 2005, the BCT met and agreed to a revised HHRA methodology for both soil and groundwater. For soil, the BCT agreed that the HHRA would be comprised of six scenarios representing total risk and six scenarios with representing incremental risk, which excludes metals with maximum concentrations detected at Parcel D below the Hunters Point ambient levels (HPAL) (PRC 1995). For groundwater, the BCT agreed to a revised HHRA methodology for groundwater incorporating the 12 most recent rounds of groundwater data for each analyte. As a result of agency comments and agreements made between members of the BCT since the draft revised FS report was submitted in 2002, this final revised FS report presents (1) an updated evaluation for federal criteria for both the A– and the B–aquifers, (2) a revised HHRA for both soil and groundwater using the appropriate exposure scenarios in accordance with planned reuses and beneficial uses of groundwater, (3) an evaluation of potential surface water quality of the Bay due to chemicals in groundwater, and (4) an updated development and evaluation of remedial alternatives. In addition, site characterization data that reflect results of completed removal actions and ongoing groundwater monitoring at Parcel D since 2002 are also provided in this FS report.

This revised FS report addresses CERCLA regulated chemicals. Potential radiological contamination will be addressed in a radiological addendum to this revised FS. Both chemical and radiological contaminants will then be addressed together in the proposed plan and the ROD.

1.2 PURPOSE AND ORGANIZATION OF THIS REVISED FS REPORT FOR PARCEL D

The purpose of this final revised FS report for Parcel D is to update the data and site characterization information available since the 1997 FS, including refining the site conceptual model; reevaluate the risks posed by contaminants in soil and groundwater at Parcel D using the updated data prior to July 2004 and the revised methodology; refine the RAOs to be consistent with the Conveyance Agreement signed in March 2004 (Navy and San Francisco Redevelopment Agency 2004); and reevaluate remedial alternatives applicable at Parcel D. The BCT will use this revised FS report to assist in evaluating the appropriate remedial actions for Parcel D to allow transfer of the property to the City and County of San Francisco.

This report was prepared in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and EPA guidance, "Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA" (EPA 1988). The NCP states that remediation should be accomplished through the use of cost-effective remedial alternatives that effectively lessen threats to and provide adequate protection of public health, welfare, and the environment (EPA 1990a). Remedial alternatives that are protective of human health and the environment are evaluated in this final revised FS report.

During the FS process, remedial alternatives are developed by assembling media-specific technologies into cleanup alternatives. The process consists of the following general steps:

- Develop RAOs that specify the contaminants and media of interest, exposure pathways, and remediation goals that permit a range of treatment and containment alternatives to be developed. RAOs are developed on the basis of chemical-specific applicable or relevant and appropriate requirements (ARAR), the HHRA results, and metals that pose potential ecological impacts to the Bay.

- Develop general response actions (GRA) for each media that define containment, removal, treatment, disposal, or other actions, singularly or in combination that can be implemented to satisfy the RAOs.

- Identify volumes or areas to which GRAs apply.

- Identify and screen remedial technologies for each GRA to eliminate technologies that cannot be implemented, technically or cost effectively, at the site. GRAs specify types of remedial technologies. For example, the GRA for a treatment can include chemical or biological technology types.

- Identify and screen process options for each remedial technology. For example, chemical oxidation and dechlorination are under the process option chemical treatment.

- Assemble process options into alternatives, screen the alternatives, and evaluate the retained alternatives.

The information in this final revised FS report is organized into seven sections. After this introduction, the remaining six sections present updated site characterization and risk assessment and the results of the FS process for Parcel D, as summarized below.

- **Section 2.0 – Hunters Point Shipyard and Parcel D Site History and Characterization** describes the current soil and groundwater conditions at Parcel D. Data presented includes RI data, interim removal action data, and additional groundwater investigation and monitoring data collected since the 1997 FS report and prior to July 2004. The site characterization update presents the nature and extent of the chemicals of concern (COC) identified in soil and groundwater based on the revised HHRA and environmental evaluation for Parcel D.

- **Section 3.0 – Risk Evaluation Summary and Remediation Goals** presents a summary of the human health risks based on the soil and groundwater conditions and planned future land uses and the evaluation of potential threats to the Bay from chemicals detected in groundwater. Remediation goals are then presented for the COCs identified from the HHRA, and trigger levels for those COCs in groundwater that pose a potential risk to the Bay.

- **Section 4.0 – Remedial Action Objectives, General Response Actions, and Process Options** presents RAOs and ARARs for Parcel D based on the site characterization, HHRA results, and the environmental evaluation. GRAs are then identified that address the RAOs and ARARs. Process options associated with each GRA are then screened for their technical and economic implementability.

- **Section 5.0 – Development and Description of Remedial Alternatives** presents a detailed description of the remedial alternatives based on the selected process options in Section 4.0 that will satisfy the RAOs. Process options recommended for consideration are assembled, singularly or in combination, to create remedial alternatives.

- **Section 6.0 – Detailed Analysis of Remedial Alternatives** presents the evaluation of each remedial alternative developed in Section 5.0 against EPA's nine evaluation criteria. The alternatives are then compared against each other to evaluate their relative advantages and disadvantages with respect to the nine evaluation criteria.

- **Section 7.0 – References** presents a list of documents and support material used to generate this report.

In addition, supporting data, calculations, and evaluations for this final revised FS report appear in the appendices as:

- **Appendix A– Analytical Results for Soil and Groundwater at Parcel D,** presents all Parcel D soil and groundwater data used in this FS report.

- **Appendix B– Parcel D Human Health Risk Assessment,** presents a detailed description of the risk methodology and results, including figures and tables for the various exposure scenarios. Section 3.1 summarizes Appendix B.

- **Appendix C– Applicable or Relevant and Appropriate Requirements** identifies and evaluates potential federal and State of California ARARs, and presents the Navy's determinations regarding these ARARs' applicability to the alternatives in this FS. The ARARs are summarized in Section 4.2.

- **Appendix D– Groundwater Beneficial Use Evaluation,** presents a detailed analysis of the beneficial use of the A-aquifer and the B-aquifer at Parcel D, to help define the appropriate exposure scenarios in the HHRA. Section 2.2.9 summarizes the beneficial use determinations for Parcel D.

- **Appendix E– Conceptual Groundwater Monitoring Approach and Exit Strategies,** presents the basis for and the proposed groundwater monitoring at Parcel D in support of the groundwater alternatives presented in this FS report. The proposed monitoring approach is used as the basis for estimating costs associated with a potential future remedial action monitoring plan.

- **Appendix F– Remedial Alternative Costs Summary,** presents detailed costs and associated assumptions for each alternative that were used to support the evaluation of the cost criterion in Section 6.0. Appendix F includes detailed spreadsheets that provide per unit costs and quantities for each line item.

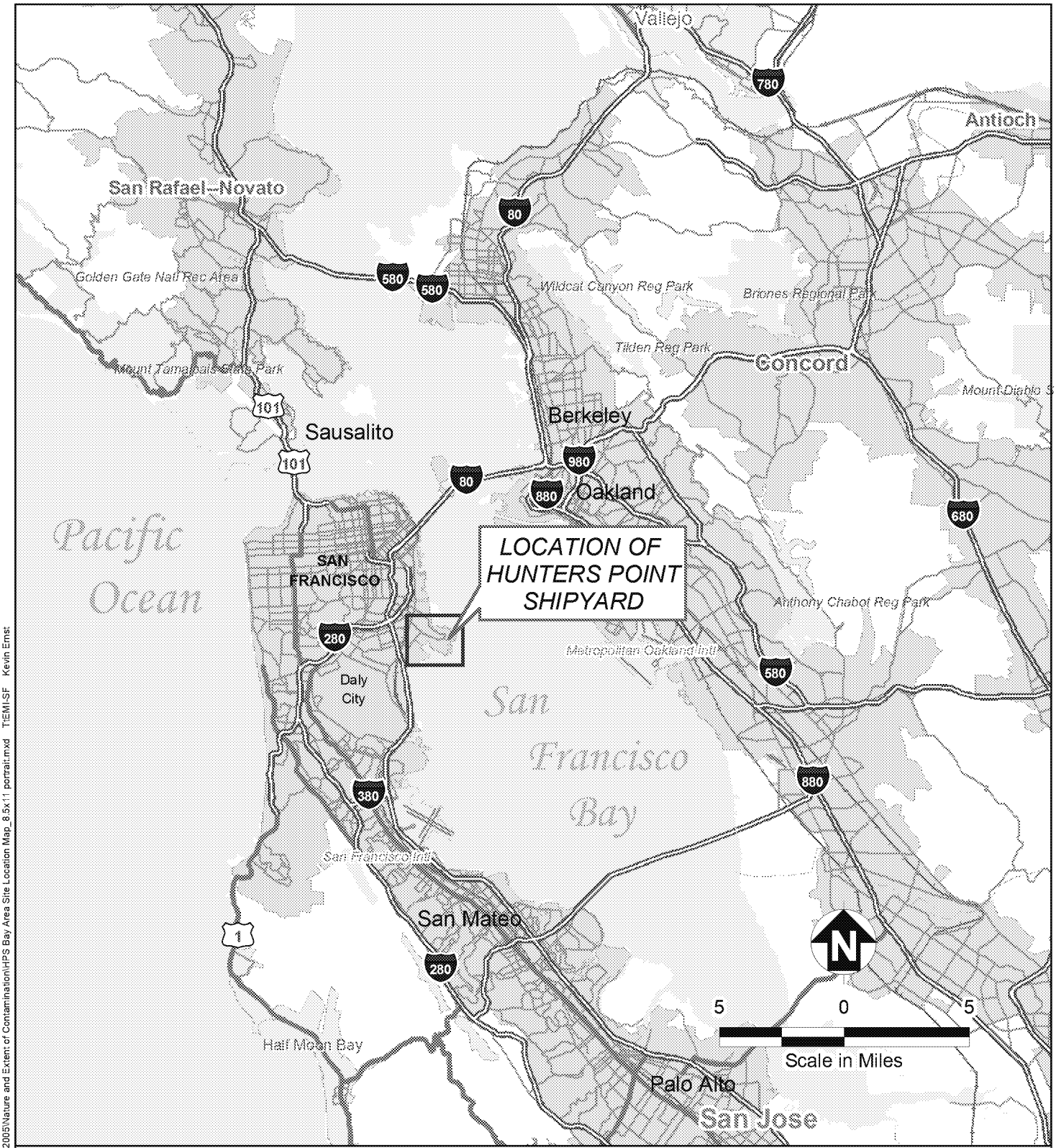
- **Appendix G – Groundwater Modeling and Calculation of Attenuation Factors,** summarizes the results of groundwater modeling for several areas at Parcel D of HPS with plume concentrations above their applicable surface water criteria.

- **Appendix H – Preliminary Screening of Groundwater Impacts to San Francisco Bay,** provides a comparison of groundwater concentrations at Parcel D with appropriate surface water quality criteria.

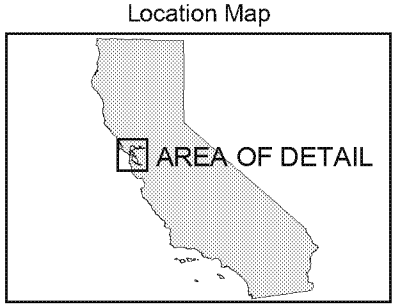
- **Appendix I – Trigger Levels for Groundwater Impacts to San Francisco Bay,** presents the applicable toxicological and physicochemical factors relevant to developing trigger levels for Plumes in Parcel D groundwater.

- **Appendix J – Responses to Regulatory Agency Comments on the Draft and Draft Final Parcel D Feasibility Study,** presents the Navy's responses to comments received from local, state, and federal agencies on the draft revised FS report submitted in 2002 and on the draft final revised FS report submitted in July 2007.

FIGURES



Location Map



SulTech

Hunters Point Shipyard, San Francisco, California

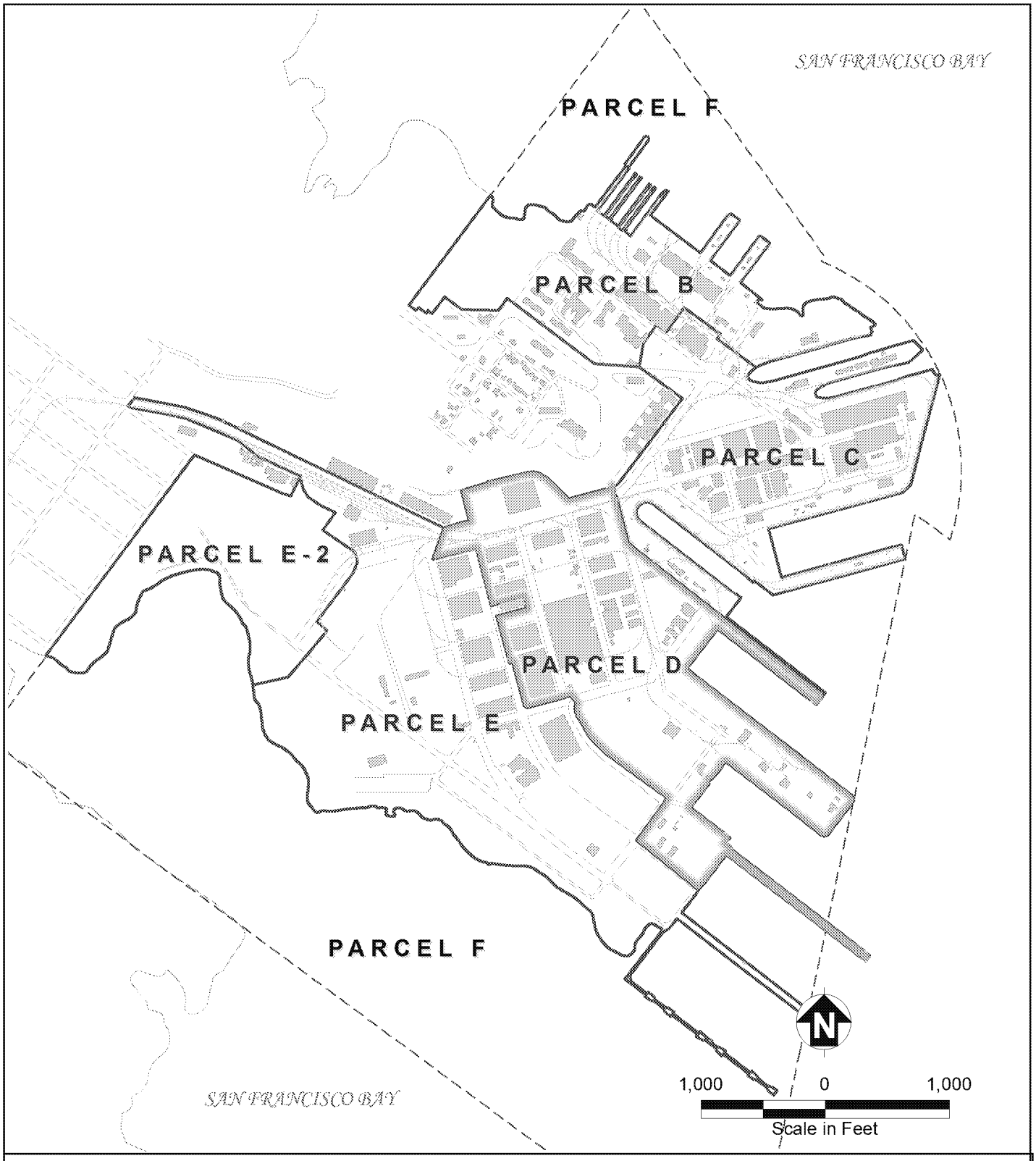
U.S. Department of the Navy, BRAC PMO West, San Diego, California

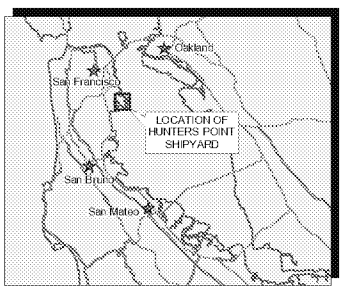
FIGURE 1-1

HUNTERS POINT LOCATION MAP

Revised Feasibility Study Report for Parcel D

2007-10-15 V:\Hunters_Point\Projects\Parcel_D\FS_2005\Nature and Extent of Contamination\HPS Bay Area Site Location Map_8.5x11 portrait.mxd TEMI-SF Kevin Ernst





Location Map

Parcel D Boundary
Other Parcel Boundaries
Parcel F Boundary
Non-Navy Property
Building
Road

SulTech

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 1-2
FACILITY LOCATION MAP

Revised Feasibility Study Report for Parcel D

2007-10-15 V:\Hunters_Point\Projects\Parcel_D\FS_2005\Nature and Extent of Contamination\Facility Location Map.mxd TtEMI-SF Kevin Ernst